Fusion of Built in Test (BIT) Technologies with Embeddable Fault Tolerant Techniques for Power System and Drives in Space Exploration, Phase I

Completed Technology Project (2010 - 2010)

Project Introduction

As NASA develops next generation space exploration systems as part of the Constellation program, new prognostics and health management tools are needed to ensure reliability, safety, mission success, and fault tolerant reconfiguration capabilities. Electrical power systems constitute a critical division of the exploration systems in enabling reliable ground and settlement operations. Even with the added hardware redundancy in the design, early diagnostics at the component level and application of fault tolerant techniques at the system level are imperative in providing an integrated reliability solution. Moreover, the proposed technology is highly adaptable across many systems of the Constellation program, including the Orion crew exploration vehicle, Altair Lunar Lander, and the lunar surface vehicles. This effort proposes an ambitious plan to improve the state-of-the-art in power system and converter (silicon and wide band gap based) in built-in-test (BIT) capabilities, enhance reliability assessment, and minimize fault propagation. Impact is proposing to develop the power system BIT capabilities based on: 1) high frequency ringing characterization in power devices, 2) an L1 norm based algorithm to monitor power quality, primarily in the converter, and 3) a dynamic differential current sensor to predict component aging and failure. These BIT techniques will continuously provide system and component level health assessment, which will be fed into the "Health Manager Reasoner" module to analyze the severity of fault and invoke the appropriate response to avoid system-wide failure propagation and enable reconfiguration techniques to promote mission completion. These techniques are mindful of the strict power, cost, size, and weight requirements for space exploration systems. They are designed to be embedded into the current configuration with minimal hardware and utilize unused processing resources.

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Table of Contents

Small Business Innovation Research/Small Business Tech Transfer

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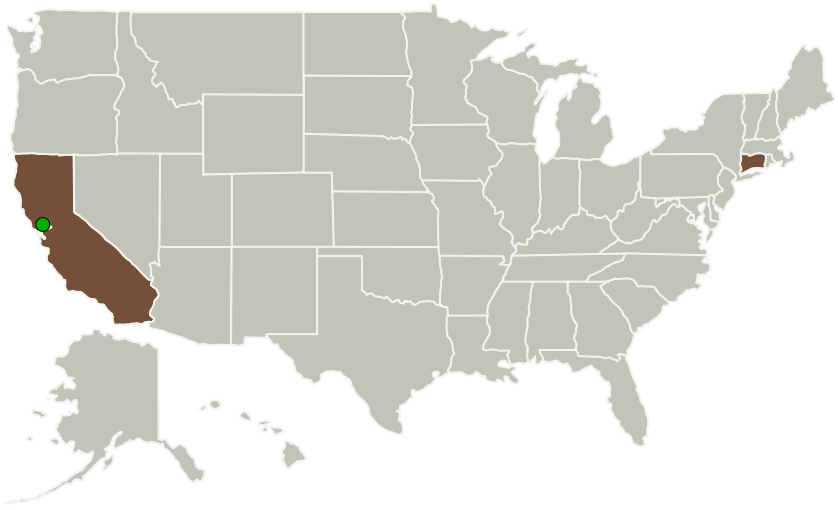
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Connecticut

Project Transitions

January 2010: Project Start

July 2010: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/140064)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

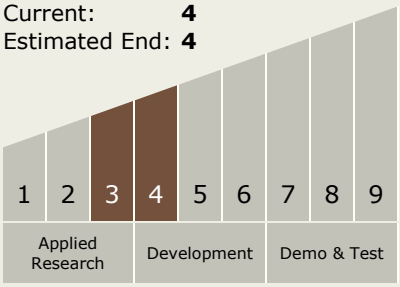
Carlos Torrez

Principal Investigator:

Antonio Ginart

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.2 Navigation Technologies
    - TX17.2.3 Navigation Sensors

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System